An Instrument for Rapid, Accurate, Determination of Fuel Moisture Content

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Moisture contents of dead and living fuels are key variables in fire behavior. Accurate, real-time fuel moisture data are required for prescribed burning and wildfire behavior predictions. The convection oven method has become the standard for direct fuel moisture content determination. Efforts to quantify fuel moisture through indirect methods have not been sufficiently site specific. Previous attempts to make direct measurements less time consuming have also been inadequate in one way or another.

Instrument Developed

A recently developed instrument (COMPU-TRAC™, manufactured by Motorola Processing, Inc.), designed to be used by a variety of industries and disciplines, may significantly shorten the time needed to determine dead and live fuel moisture for those people trying to predict prescribed or wildfire behavior and effects. It can be used both in the laboratory and in the field.

This moisture analyzer is actually a miniature oven. The sample is dried on a pan connected directly to a rugged weight sensor. It has solid-state electronics throughout and a built-in computer system that eliminates calibrating, weighing, balancing, and making mathematical calculations. It completely eliminates operator skill and judgment factors. Moisture content readings are obtained in 5 to 20 minutes. Because the instrument is completely automatic, the operator is left free to complete other tasks while the instrument processes the material—a distinct advantage over other methods.

Small Size

The moisture analyzer weighs 26 pounds and is completely portable (possibly air dropable). Its physical dimensions are 19 inches wide by 8 inches high, and 10 inches deep. The analyzer can be run on generated 120 volt-60 Hz power, and is accurate even at wide variations of electrical input from as low as 90 volts to as high as 150 volts. The instrument draws 6 amps when the heating element is on—an equivalent of 710 watts—and 1 amp when not heating. LED indicator lights display three-digit readings of moisture content. An array of other indicator lights provides a continuous status check of the instrument.

Sample Process

Since the samples must be small, it is important that they be adequate and representative of the fuels being considered. Samples should be collected specifically from the area where wildfire behavior is being predicted or prescribed fire decisions are being made. A variety of leakproof sample containers are available. Autoclavable plastic bottles are perhaps the best, but glass jars with airtight lids or seamless metal tins also may be used.

The number of samples must be large enough to provide adequate information for estimating the average fuel moisture if a lot of variability is present. The samples should be stratified to eliminate combining fuels with known differences in moisture content, such as samples from sunny or shaded sites. If samples are combined for a single estimate of an area, each should be

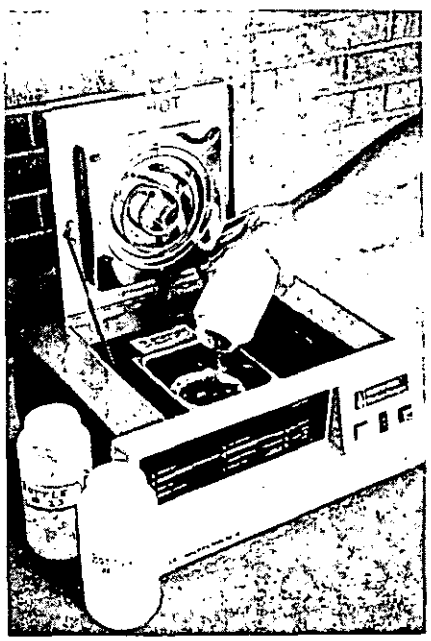

Figure 1.—Samples are "sprinkled" on a pan inside the moisture analyzer

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weighted according to the portion of total area it occupies within each stratum. Samples should not be exposed to conditions that will cause the moisture to start evaporating from the material and collecting as condensation inside the container. This situation can be eliminated by not allowing the sample to be exposed to radiant (sunlight) heating which allows the fuel sample to be hotter than its surroundings. Quickly getting the sample back for processing also helps.

Operating Procedures

The moisture analyzer is simple to operate. Samples are "sprinkled" on a pan inside the analyzer (fig. 1) until a light and beeper indicate the proper amount has been added. After the door is closed, the weighing and drying process takes place. All calculations are made automatically within the microprocessor. Approximately 5 to 20 minutes later, the moisture content is illuminated on the instrument panel. A light and beeper also "tell" the operator the process is complete. Because the sample pan is only 4.25 inches in diameter, it is sometimes necessary to cut the sample into smaller pieces. For instance, we cut ponderosa pine needles into ½- to ¾-inch segments, making sure to include both fascicle and tip ends. The sample pan can be emptied and cleaned easily. The instrument is best suited to small-dimension (fine) fuels.

Rapid determination of fuel moisture can greatly enhance the accuracy of predictions and decisions based on the effects of fuel moisture. Tests comparing the moisture analyzer data from a mechanical convection oven yielded a coefficient of determination (r^2) of 0.98.

Summary

Moisture content of forest fuels is a key variable in fire behavior. Indirect and direct methods of determining fuel moisture are often inadequate. An instrument was recently tested, COMPU-TRAC^{tm}, that accurately measures fuel moisture directly in a short time. The moisture analyzer completely eliminates operator skill and judgment by using a rugged load sensor and electronic microprocessor to automatically process fuel moisture samples.